Dear Manufacturer:

Subject: Deterioration Factors for Nonroad Diesel Engines

If you manufacture engines with ratings less than 37 kilowatts, you started using deterioration factors (DFs) in model year 1999. If you manufacturer engines with ratings greater than or equal to 37 kilowatts, you will need to develop DFs for your certification to Tier 2 standards. DFs are required for all pollutants including smoke. This document provides guidance on generating and applying DFs.

Engines must comply with emissions standards throughout their useful lives. Certification engines are tested with up to 125 hours of service accumulation. By definition, the useful life for engines ranges from 3000 to 8000 hours. Deterioration factors are applied to account for any increase in emissions over the useful life of an engine. DFs are usually developed using an engine which is run strictly for aging purposes, and are applied to the emission results from the certification engine. The certification engine must comply with emissions standards after the DFs are applied. DFs are also applied to test results during a Selective Enforcement Audit (SEA).

NOx, NMHC, CO and PM DFs for engines with aftertreatment devices are multiplicative. Multiplicative DFs are the ratios of the emissions measured (or extrapolated) at the end of the useful life to the emissions measured at the 125 hour point. A multiplicative DF cannot be less than 1.000. Engines without aftertreatment have additive NOx, NMHC, CO and PM DFs. Smoke DFs are additive for all engines. Additive DFs are determined by subtracting emissions measured at the 125 hour point from the emissions measured (or extrapolated) at the end of the engine's useful life. An additive DF cannot be less than 0.000. You may use DF data for multiple model years (carry-over DFs) as long as you do not make any emissions related changes to the engine. With EPA approval, you can use DFs which you developed for one family on other families if they use similar technologies.

Calculate the final NMHC+NOx emission result by first applying your NOx DF to your NOx result and your NMHC DF to your NMHC result. Then add the deteriorated NOx value and the deteriorated NMHC value to determine the deteriorated NMHC+NOx result.

Using engineering judgement to develop DFs for model years 1999 and 2000

Given the short time from the signing of the final rule to its implementation, paragraph 89.118(e)(3)(iii)(E) provides an interim procedure for model years 1999 and 2000.

Manufacturers may determine deterioration factors based on good engineering judgement and reasonably available information.

For the 1999 and 2000 model years, EPA is accepting DFs determined from any available emissions data on aged engines. No minimum amount of service accumulation is specified for these model years. You should be prepared to provide the basis you used to develop your DFs.

You can't propose a NOx DF of zero based on the assumption that NOx emissions decrease with increasing engine wear. This is not acceptable engineering judgement. Acceptable engineering judgement relates changes in measurable parameters to changes in exhaust emissions. For example, a PM DF may be determined by relating increased oil and fuel consumption to increased PM emissions. In this example, you should have data indicating the measured increase in fuel or oil consumption and the expected PM increase per change in fuel and/or oil consumption.

For model years 1999 and 2000, we can assign DFs to you if you do not have sufficient data on emissions or other engine parameters. The assigned DFs are based on data submitted by other manufacturers.

Model Year 2001

Beginning in the 2001 model year, EPA expects manufacturers to have completed their DF analysis; assigned DFs will not be available. For some manufacturers, carryover of 2000 model year DFs may not be accepted because of insufficient emissions deterioration data. We encourage you to discuss your DF plans for model year 2001 with your certification representative as soon as possible.

Dynamometer testing of durability engines

EPA did not specify a durability test cycle for nonroad engines. We believe any test cycle that reflects actual in-use operation or incorporates modes from the certification test cycle to be appropriate.

You should measure emissions at enough points during the durability testing to determine the change in emissions with time. You should measure emissions at more than just the beginning and end of your dynamometer testing. Your emission data points should be approximately equally spaced throughout your durability testing. It may not be necessary to age an engine to its full useful life in order to determine useful life emissions. These emissions may be projected. For example, the durability cycle run by you may be more severe than the test cycle in the regulations. Therefore, your durability test cycle may more rapidly age the engine than by repeated running of the emissions test cycle. Once you have accumulated enough emissions data to determine a trend, you may extrapolate to determine the useful life emissions. As an alternative to accumulating engine hours on a dynamometer, in-use engines may be tested at various hours throughout their useful life.

Allowable maintenance

Section 89.109 specifies allowable intervals for emissions related maintenance. Apply these maintenance intervals while accumulating hours on the durability engine. For critical emission-related components, you must document that the maintenance is likely to occur in-use. The regulations list options for demonstrating that the maintenance is occurring in-use. If you can't document that the maintenance is likely to occur in-use, you can't perform the maintenance.

If you have any questions on the information in this letter, please contact Greg Orehowsky of my staff on 202-564-9292 or at orehowsky.gregory@epa.gov.

Sincerely,

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